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(54) Abstract Title
Particulate material for waste water treatment

(57) A particulate material suitable for forming a bed for waste water treatment comprises pellets of a plastics material, e.g. high density polyethylene, whose surface is at least partially coated with smaller particles of sand and salt. The material may be made by mixing pellets of the plastics material with a mixture of sand and salt that has been preheated to a temperature between that at which surface melting of the pellets takes place and that at which a substantial proportion of the pellets agglomerate. After mixing the particulate material is separated from the sand and salt, and the pellets of plastics material having sand and salt embedded in their surface are recovered. On washing, the salt is removed to form voids which provide a habitat for microorganisms, and the material can be used in static or fluidised bed waste water treatment.

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PARTICULATE MATERIAL FOR WASTE WATER TREATMENT

The present invention relates to a particulate material suitable for forming into a bed for the treatment of waste water, to a method for making the particulate material, and to a waste water treatment method using the material.

A wide range of methods and apparatus have been disclosed for the aeration of sewage or other waste water containing dissolved organic matter. There is disclosed in international publication W095/17351 a water treatment vessel which contains a fluidizable bed of loose particulate material comprising particles of sharp sand adhered to granules of polyethylene. These particles are stated to provide a habitat for micro-organisms which are effective in waste water treatment. The material has a density slightly greater than 1.0g/cc, a specific surface area of $600\text{m}^2/\text{m}^3$ and a particle size range of 3-10mm. The bed may be fluidised and aerated by air bubbles released at the base of the bed.

The present invention is concerned with the provision of a particulate material of the above general kind which is more effective in waste water treatment.

In one aspect the present invention provides a

particulate material suitable for forming into a bed for waste water treatment, said material comprising macro-particles of a plastic material having a surface at least partially covered with sand and salt. The above material
5 can be washed to remove the salt and form voids which contribute a habitat for microorganisms having a relatively large area per unit weight of the material whilst the sand is permanently retained on the surface.

10 The particulate material may be made by providing particles of a plastics material, and mixing them with sand and salt that have been preheated to a temperature between that at which surface melting of the particles takes place and that at which an unacceptable degree of
15 agglomeration of the particles takes place, separating the particles from the unadhered sand and salt, and recovering particles of plastics material having sand and salt embedded in their surface. The appropriate preheating temperature will vary depending upon the
20 nature of the plastics material but can readily be determined by routine trial.

The particulate material may be placed in a water treatment pond, tank or vessel, and washed to remove the
25 salt present before the waste water treatment begins. Alternatively, the material can be subjected to a washing step before it is installed in the treatment vessel and

optionally before it is packaged for delivery to a water treatment works. In either case, the salt which has been coated onto or embedded in the surface of the plastics material eventually becomes removed to form small spaces
5 between the particles of sand which provide locations within which growth of micro-organisms is encouraged.

The pellets may be of any suitable thermoplastic material which over a long period of time is unaffected by water.
10 For example, polyethylene and polypropylene are suitable, in particular high density polyethylene. The material may be provided in the form of beads or pellets of size about 3-10mm, typically about 3mm x 9mm.

15 The sand is preferably commercially available sharp sand 25-80% of which passes a 600µm sieve.

The salt used may be granular, and may be of size such that about 100% passes through a 600µm sieve.

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In manufacture, the particulate material is treated so that the sand and salt become embedded into the previously molten surface of the pellets. The amount of sand which becomes incorporated into the surface of the
25 particles is preferably such that after they have been washed they have a density of more than 1.0g/cc preferably about 1.0 to 1.3g/cc. The amount of salt by

weight is greater than the amount of sand and when the material is washed, the salt creates voids in the surface of the particles. Preferably the amount of salt present is such that the washed particles have a specific surface
5 area of about $600\text{m}^2/\text{m}^3$. Thus the weight ratio of salt to sand may be in the ratio of 10:1 to 1:1, preferably about 7:1 to about 8:1, and the weight ratio of the plastics material to the salt and sand mixture is from 1:1 to 1:10, especially about 1:3.

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The sand and salt are preferably preheated to a temperature at which the surface of the pellets of plastics material becomes molten, but an unacceptable degree of agglomeration of the pellets does not take
15 place under the selected mixing conditions e.g. rotational mixing or tumbling. The temperature to which the sand and salt have to be preheated to achieve this result varies depending on the nature of the plastics material but for high density polyethylene, it has been
20 found that a temperature of $215^\circ\text{C} \pm 5^\circ\text{C}$ is suitable. It has been found that in practice that it is difficult to avoid the formation of some macroscopic agglomerates during the mixing process, and these are extracted e.g. using a perforated plate. After a short mixing period,
25 the mixture of pellets, sand and salt is cooled by adding additional salt and sand mixture at ambient temperatures. Subsequently, the mixture is separated into a recycle of

salt-sand mixture and of particles which are coated with sand and salt.

5 The product containing the salt may be packaged directly into sacks or containers. Alternatively, it may be washed, separated from the wash water, and packed into sacks or containers.

10 The particulate material may be used for waste water treatment by passing the waste water through a bed of particles made as described above. The bed may be in the form of a static bed or tank contain a static bed, or it may be in the form of a fluidised bed. In particular, the particles may be used in the waste water treatment
15 process disclosed in WO95/15351.

The invention will now be described in the accompanying example.

EXAMPLE

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Two rotary concrete mixers were provided together with a burner for heating the contents of one of the mixers, and a thermocouple. The first rotary mixer was charged with sand (6kg) and salt (44kg) and set to
25 rotate. The second rotary mixer was charged with high density polyethylene (15kg) in the form of pellets of size 3mm x 9mm. The first mixer was heated by means of

a burner to bring the contents to about 215°C as determined by the thermocouple. When the contents of the first mixer had obtained this temperature, the heat was removed, the second mixer was set to rotation, and the contents of the first mixer were introduced into the second mixer in four portions with about 10 seconds delay between each portion. An excess of the salt/sand mixture was present, and formation of the product (i.e. melting of the surface of the high density polyethylene pellets and adherence of the salt and sand particles thereto takes place within a few seconds. However, mixing was continued for about 2 minutes after the final portion of sand and salt had been introduced. During this period, the contents of the second mixer were visually examined, and any large agglomerates observed were removed using a sheet of perforated metal. Subsequently a further mixture of salt (24kg) and sand (3kg) was added to the second mixer to cool the contents thereof, after which the resultant mixture was poured out onto a sieve which was agitated to remove loose salt and sand which was retained for use in the production of a subsequent batch of product. The product particulate material which was retained by the sieve was washed with water, hydroextracted and packed in plastics sacks.

CLAIMS

1. A particulate material suitable for forming a bed for waste water treatment, said material comprising pellets of a plastics material having a surface at least partially coated with smaller particles of sand and salt.
2. The material of claim 1, wherein the plastics material is polyethylene.
3. The material of claim 2, wherein the plastics material is high density polyethylene.
4. The material of claim 3, wherein the pellets are of size 3-10mm.
5. The material of any preceding claim, wherein the pellets are of size about 3mm x 9mm.
6. The material of any preceding claim, wherein the sand is of particle size such that 25-80% passes through a 600µm sieve.
7. The material of any preceding claim, wherein the sand is sharp sand.
8. The material of any preceding claim, wherein the

salt is of size such that 100% passes through a 600 μ m sieve.

9. The material of any preceding claim, wherein sand
5 and salt are embedded into a previously molten surface of the pellets.

10. The material of any preceding claim, which after washing has a density of more than 1.0 to 1.3g/cc.

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11. The material of any preceding claim, which when washed has a specific surface area of about 600m²/m³.

12. A method for making a particulate material suitable
15 for forming a bed for waste water treatment, said method comprising mixing pellets of a plastics material with particles of sand and particles of salt that are preheated to a temperature between that at which surface melting of the pellets takes place and that at which a
20 substantial proportion of the pellets agglomerate, separating the particulate material from the sand and salt, and recovering pellets of the plastics material with sand and salt embedded in their surface.

25 13. A method of claim 12, wherein the pellets are of high density polyethylene.

14. The method of claim 12 or 13, wherein the pellets are of size 3-10mm.

15. The method of claim 12, 13 or 14, wherein weight ratio of salt to sand in the preheated mixture is 10:1 to 1:1.

16. The method of any of claims 12 to 15, wherein the weight ratio of salt to sand in the preheated mixture is 7:1 to 8:1.

17. The method of any preceding claim, wherein the weight ratio of the plastics material to the salt and sand mixture is from 1:1 to 1:10.

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18. The method of claim 17, wherein the weight ratio of the plastics material to the salt and sand mixture is about 1:3.

19. The method of any claims 12 to 18, wherein the plastics material is high density polyethylene and the salt and sand mixture is preheated to a temperature of 210-220°C and then mixed with the pellets.

20. The method of any of claims 12 to 19, further comprising the step of separating large agglomerates from the mixture of pellets, sand and salt.

21. The method of any claims 12 to 20, further comprising the step of cooling the mixture of pellets, sand and salt by adding additional salt and sand mixture at ambient temperature.

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22. The method of any of claims 12 to 21, wherein the mixing is carried out in a rotary or tumbling mixer.

23. The method of making a particulate material suitable
10 for forming a bed for waste water treatment substantially as described in the foregoing example.

24. The method of any of claims 12 to 23, further comprising washing the coated pellets to remove salt
15 therefrom.

25. A waste water treatment method which comprises passing waste water through a bed of pellets as claimed in claim 11 or made by the method of claim 24.

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26. The method of claim 25, wherein the bed is a fluidised bed.

27. A particulate material suitable for forming a bed
25 for waste water treatment, comprising particles of a plastics material surface coated with smaller sand and salt particles.

28. A particulate material suitable for forming a bed
for waste water treatment comprising particles of a
plastics material coated with smaller sand particles, the
surface of the plastics material having voids or
5 indentations for providing a habitat for microorganisms.



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Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B2E, B1D(DBFA)

Int Cl (Ed.6): B01D 39/02 39/04 39/06; C02F 3/10 3/12

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 2302293 A (TODD), whole document	1-4, 9,10, 12-14, 19, 21,22, 24-28
X	WO 96/25367 A (PROCEFF LTD), whole document	1-5, 7, 9-16, 24-28
X	WO 95/17351 A (PROCEFF LTD), see Fig 3 and p10 line 26 - p11 line 11	28

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.